



Partial-Vacuum-Gasketed Electrochemical Corrosion Cell

This cell is designed to reduce the incidence of crevice corrosion.

John F. Kennedy Space Center, Florida

An electrochemical cell for making corrosion measurements has been designed to prevent or reduce crevice corrosion, which is a common source of error in prior such cells. In a typical prior corrosion cell, crevice corrosion occurs at an interface between a material specimen, an electrolyte, and a specimen-mounting fixture. Crevice corrosion significantly alters current and voltage responses, thereby generating errors in the determination of both the thermodynamic and kinetic aspects of corrosion.

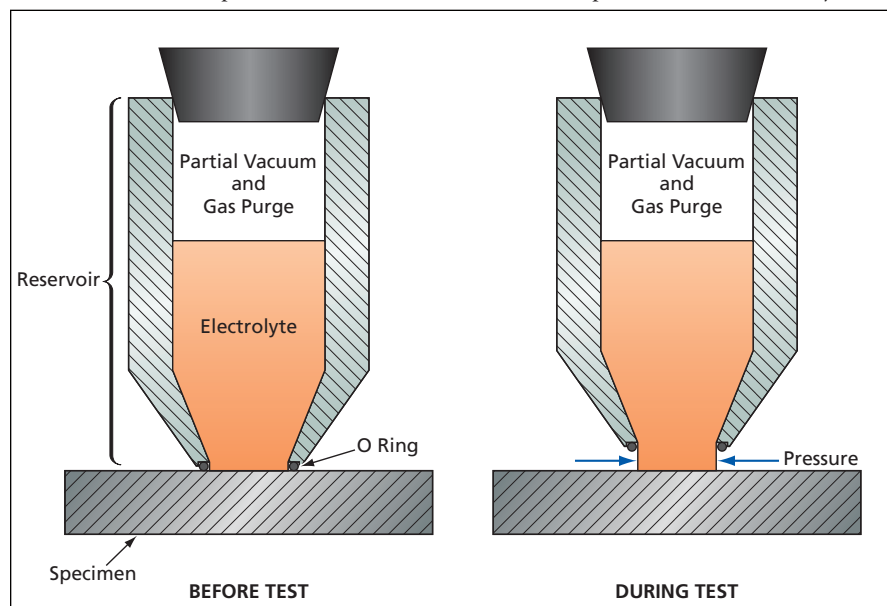
The present cell (see figure) includes an electrolyte reservoir with O-ring-edged opening at the bottom. In preparation for a test, the reservoir, while empty, is pressed down against a horizontal specimen surface to form an O-ring seal. A purge of air or other suitable gas is begun in the reservoir, and the pressure in the reservoir is regulated to maintain a partial vacuum. While maintaining the purge and partial vacuum, and without opening the interior of the reservoir to the atmosphere, the electrolyte is

pumped into the reservoir. The reservoir is then slowly lifted a short distance off the specimen. The level of the partial vacuum is chosen such that the differential pressure is just sufficient to keep the electrolyte from flowing out of the reservoir through the small O-ring/specimen gap. Electrochemical measurements are then made. Because there is no gasket (and, hence, no crevice between the specimen and the gasket), crevice corrosion is unlikely to occur.

This cell is easy to operate, uses a relatively small volume (10 to 25 mL) of electrolyte, accommodates specimens of various sizes, does not leave rubber O-ring residues on specimens, is inherently suitable for testing with electrolytes that must be purged with gases, and can easily be cleaned. Simple modifications can be performed to enable use of this cell in special crevice-free corrosion tests — for example, tests for determining critical pitting temperatures.

Inasmuch as the purge gas can quickly diffuse into the electrolyte, careful selection of the purge gas is necessary to ensure reliable results. Water-line corrosion could introduce small errors into some measurements.

This work was done by Andrew P. Bonifas and Luz M. Calle of Kennedy Space Center and Paul E. Hintze funded by the National Research Council at Kennedy Space Center. Further information is contained in a TSP (see page 1). KSC-12765



Differential Pressure between the atmosphere and the partial vacuum above the reservoir keeps the electrolyte in the reservoir when the reservoir is lifted a short distance off the specimen. The gap between the bottom of the reservoir and the specimen is exaggerated here for clarity.

Theodolite Ring Lights

These lights facilitate the use of spherical tooling balls as position references.

Goddard Space Flight Center, Greenbelt, Maryland

Theodolite ring lights have been invented to ease a difficulty encountered in the well-established optical-metrology practice of using highly reflective spherical tooling balls as position references. As described in more detail below, a theodolite ring light is at-

tached to a theodolite or telescope and used to generate a visible target on a tooling ball.

A common technique for aiming an instrument (specifically, a theodolite or an alignment telescope) precisely at the center of a tooling ball involves the use

of an autocollimating device. This technique is less than ideal because the reflection from the ball is demagnified by the spherical surface of the ball. The demagnification makes it extremely difficult to resolve the reflection and align it accurately within the cross hairs of the



The **Prototype Theodolite Ring Light** is shown here mounted on the objective-lens housing of a theodolite.

instrument. This difficulty increases with increasing distance and with decreasing size of the ball. Also, the autocollimating device adds greatly to the cost of the instrument.

A theodolite ring light produces a more easily visible reflection and elimi-

nates the need for an autocollimating device. A theodolite ring light is a very bright light source that is well centered on the optical axis of the instrument. It can be fabricated, easily and inexpensively, for use on a theodolite or telescope of any diameter. It can be quickly

mounted on or removed from the instrument. No calibration or modification of the instrument is needed. Moreover, the theodolite ring light does not reduce the field of view of the instrument and does not scatter light into the objective-lens housing of the instrument.

A theodolite ring light consists of a number of light-emitting diodes (LEDs) placed at equal angular intervals in a ring sized to fit snugly over the objective lens of the instrument. The prototype theodolite ring light, shown in the figure, includes eight 5.5-candela blue light-emitting diodes (LEDs) mounted in a ring fabricated of black polyacetal. The LEDs are powered by two D-size alkaline cells. In general, the number, brightness, and color of the LEDs can be chosen according to the conditions prevailing in a given measurement environment.

The prototype has been used to locate tooling balls of 0.5-in. (1.27-cm) and 1-in. (2.54-cm) diameter at distances from 10 to 25 ft (about 3 to 7.6 m). Operators consistently achieved accuracy and repeatability at or near the limiting resolution of the instrument. These results were significantly better than those typically obtained with conventional targets. In addition, the extreme demagnification by the small spherical target surfaces eliminated the need for calibration and for fabricating the ring to close tolerances.

*This work was done by David Clark of **Goddard Space Flight Center**. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810.*

GSC-14898-1